

# PAMS: Enhanced Ozone & Precursor Monitoring

## Background

Of the six criteria pollutants, ozone is the most pervasive. The most prevalent photochemical oxidant and an important contributor to “smog,” ozone is unique among the criteria pollutants because it is not emitted directly into the air. Instead, it results from complex chemical reactions in the atmosphere between VOCs and NO<sub>x</sub> in the presence of sunlight. There are thousands of sources of VOCs and NO<sub>x</sub> located across the country. To track and control ozone, EPA must create an understanding of not only the pollutant itself, but the chemicals, reactions, and conditions that contribute to its formation as well.

Section 182(c)(1) of the CAA called for improved monitoring of ozone and its precursors, VOC and NO<sub>x</sub>, to obtain more comprehensive and representative data on ozone air pollution. Responding to this requirement, EPA promulgated regulations to initiate the Photochemical Assessment Monitoring Stations (PAMS) program in February 1993. The PAMS program requires the establishment of an enhanced monitoring network in all ozone nonattainment areas classified as serious, severe, or extreme. The 21 affected ozone areas listed in Table 4-1 have a total population of 78 million. Although only encompassing 18 percent of the total number of original ozone nonattainment areas, PAMS areas account for 79

percent of the total number of non-attainment area ozone exceedance days, as seen in Figure 4-1.

## Network Requirements

Each PAMS network consists of as many as five monitoring stations, depending on the area’s population. These stations are carefully located according to meteorology, topography, and relative proximity to emissions sources of VOC and NO<sub>x</sub>. Each PAMS network generally consists of four different monitoring sites (Types 1, 2, 3, and 4) designed to fulfill unique data collection objectives.

- The Type 1 sites are located upwind of the metropolitan area to measure ozone and precursors being transported into the area.
- The Type 2 sites are referred to as maximum precursor emissions impact sites. As the name implies, they are designed to collect data on the type and magnitude of ozone precursor emissions emanating from the metropolitan area. Type 2 sites are typically located immediately downwind of the central business district and operate according to a more intensive monitoring schedule than other PAMS stations. Type 2 sites also measure a greater array of precursors than other PAMS sites and are suited for the evaluation of

**Table 4-1.** Metropolitan Areas Requiring PAMS

<b>EXTREME</b>	
1.	Los Angeles-South Coast Air Basin, CA <sup>1</sup>
<b>SEVERE</b>	
2.	Baltimore, MD
3.	Chicago-Gary-Lake County (IL), IL-IN-WI <sup>2</sup>
4.	Houston-Galveston-Brazoria, TX
5.	Milwaukee-Racine, WI <sup>2</sup>
6.	New York-New Jersey-Long Island, NY-NJ-CT
7.	Philadelphia-Wilmington-Trenton, PA-NJ-DE-MD
8.	Sacramento, CA
9.	SE Desert Modified AQMA, CA <sup>1</sup>
10.	Ventura County, CA
<b>SERIOUS</b>	
11.	Atlanta, GA
12.	Baton Rouge, LA
13.	Boston-Lawrence-Worcester, MA-NH
14.	Greater Connecticut, CT
15.	El Paso, TX
16.	Portsmouth-Dover-Rochester, NH-E
17.	Providence-Pawtucket-Fall River, I-MA
18.	San Diego, CA
19.	San Joaquin Valley, CA
20.	Springfield, MA
21.	Washington, DC-MD-VA
1.	Los Angeles-South Coast and SE Desert Modified AQMA are combined into one PAMS area referred to as South Coast / SEDAB.
2.	Chicago and Milwaukee are combined into one PAMS area referred to as Lake Michigan.

urban air toxics. For larger non-attainment areas, a second Type 2 site is required in the second-most predominant wind direction.

- The Type 3 stations are intended to measure maximum ozone concentrations and are sited farther downwind of the urban area than the Type 2 sites.
- The Type 4 PAMS sites are located downwind of the nonattainment area to assess ozone and precursor levels exiting the area and potentially contributing to the ozone problem in other areas.

In addition to the surface monitoring sites described above, each PAMS area also is required to monitor upper air meteorology at one representative site. Regulations allow a 5-year transition or phase-in schedule for the program at a rate of at least one station per area per year. The first official year of implementation for PAMS was 1994. As of September 1997, there were 75 operating PAMS sites.

Monitoring Requirements

The data collected at the PAMS sites include measurements of ozone, NO<sub>x</sub>, a target list of VOCs (including several carbonyls, see Table 4-2), plus surface and upper air meteorology. Most PAMS sites measure 56 target hydrocarbons on an hourly or 3-hour basis during the PAMS monitoring season. The Type 2 sites also collect data on three carbonyl compounds (formaldehyde, acetaldehyde, and acetone). Included in the monitored VOC species are 10 compounds classified as hazardous air pollutants (HAPs). The PAMS program is the only federally mandated initiative that requires routine monitoring of HAPs; for more information on HAPs see Chapter 5, “Air Toxics.” All PAMS stations measure ozone,

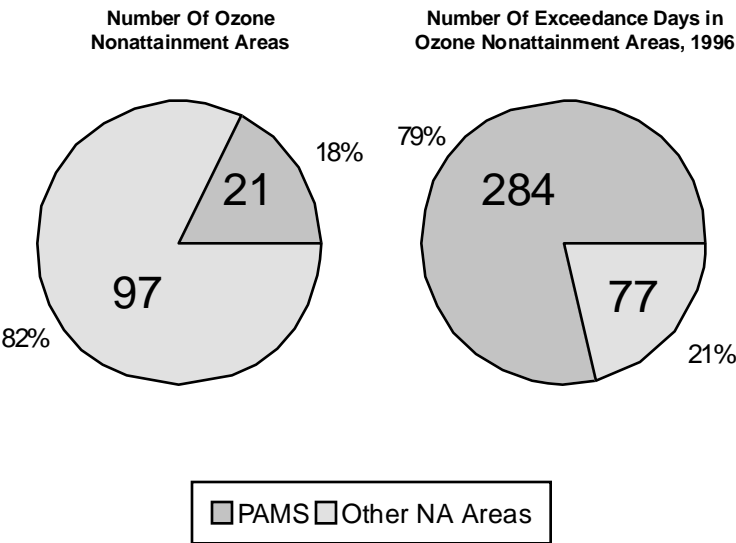


Figure 4-1. PAMS percent of total number of ozone nonattainment areas and 1996 ozone exceedance days (total number of original classified and section 185a ozone nonattainment areas = 118; total number of 1996 exceedance days in original nonattainment areas = 361.)

Table 4-2. PAMS Target List of VOCs

Hydrocarbons		
Ethylene	2,3-Dimethylbutane	3-Methylheptane
Acetylene	2-Methylpentane	n-Octane
Ethane	3-Methylpentane	*Ethylbenzene
Propylene	2-Methyl-1-Pentene	*m&p-Xylenes
Propane	*n-Hexane	*Styrene
Isobutane	Methylcyclopentane	*o-Xylene
1-Butene	2,4-Dimethylpentane	n-Nonane
n-Butane	*Benzene	Isopropylbenzene
t-2-Butene	Cyclohexane	n-Propylbenzene
c-2-Butene	2-Methylhexane	m-Ethyltoluene
Isopentane	2,3-Dimethylpentane	p-Ethyltoluene
1-Pentene	3-Methylhexane	1,3,5-Trimethylbenzene
n-Pentane	*2,2,4-Trimethylpentane	o-Ethyltoluene
Isoprene	n-Heptane	1,2,4-Trimethylbenzene
t-2-Pentene	Methylcyclohexane	n-Decane
c-2-Pentene	2,3,4-Trimethylpentane	1,2,3-Trimethylbenzene
2,2-Dimethylbutane	*Toluene	m-Diethylbenzene
Cyclopentane	2-Methylheptane	p-Diethylbenzene
		n-Undecane
Carbonyls		
*Formaldehyde	Acetone	*Acetaldehyde
	*Hazardous Air Pollutants	

NO<sub>x</sub>, and surface meteorological parameters on an hourly basis. In general, the PAMS monitoring season spans the three summer months when weather conditions are most conducive for ozone formation. EPA allows states flexibility in network design and sampling plans in recognition of the fact that each PAMS area has its own unique characteristics and demands.

### Program Objectives

EPA believes that data gathered by PAMS will greatly enhance the ability of state and local air pollution control agencies to effectively evaluate ozone nonattainment conditions and identify cost-effective control strategies. The Agency also anticipates that the measurements will be of substantial value in verifying ozone precursor emissions inventories and in corroborating estimates of area-wide emissions reductions. The data will be used by states to evaluate, adjust, and provide input to the photochemical grid models used to develop ozone control strategies, as well as demonstrate their success. PAMS will provide information to evaluate population risk exposure, expand the data base available to confirm attainment/nonattainment decisions, and develop ozone and ozone precursor trends.

EPA is extremely committed to the analysis and interpretation of PAMS data. Federal grant funds are allocated annually to state, local, and consolidated environmental agencies for data characterization and analysis. Extensive in-house PAMS analyses are also being performed at EPA. There are a number of tools and techniques available for PAMS analysis; EPA continues to develop and refine these tools as well as coordinate workshops and training. A new PAMS web site (<http://www.epa.gov/oar/oaqps/pams>) has

been introduced to help disseminate PAMS analysis-related information as well as general program material.

### VOC Characterization

As previously mentioned, each PAMS area has its own unique characteristics. Although the mix of VOC emission point sources affecting PAMS areas vary significantly by area, there are some mobile and area VOC emission sources that are common to all. These sources produce similarities in the overall composition of VOC in the ambient area. Table 4-3 shows 1996 composite rankings for 45 reporting sites of 6–9 am mean concentrations (in parts per billion Carbon [ppbC]) of the PAMS VOC target list. Morning hours are generally considered an appropriate indicator for VOC emissions since emission source activity is high and photochemical reactivity and mixing heights are still low. On average, the top 10 compounds at each site accounted for about 65 percent of the total targeted ppbC.

Though all the PAMS-targeted VOCs (as well as additional reactive sources of carbon) contribute to the formation of ozone, each VOC reacts at a different rate and with different reaction mechanisms. Ozone yield for a VOC depends significantly on the conditions within the polluted atmosphere in which it reacts, such as VOC to NO<sub>x</sub> ratio, VOC composition, and sunlight intensity. Although faster reacting VOCs may produce more ozone in a shorter time period than do slower reacting ones (under similar conditions), the ozone yields may be more comparable when viewed over a longer time span. How this affects a particular locality would depend on weather patterns and the possibility of stagnant air masses developing. Since 1977, EPA's reactivity policy has been to define as

VOCs subject to air pollution regulation all organic compounds which participate in atmospheric photochemical reactions, except certain compounds that EPA has defined as having negligible reactivity. These negligibly reactive compounds are not considered to be VOC for regulatory purposes. Two PAMS target compounds, ethane and acetone, are in this group. With the exception of the negligibly reactive compounds, all VOCs are required to be controlled equally. An alternative approach to ozone forming potential was developed by Dr. William Carter of the University of California. In 1994, Carter published a set of "ozone forming potential" factors known as the Maximum Incremental Reactivity (MIR) scale.<sup>1</sup> Carter's MIR factors were derived by adjusting the NO<sub>x</sub> concentration in the base case scenario to yield the highest incremental reactivity for each evaluated VOC; the factors also were based on ozone yields produced per single day of sunlight exposure. Carter's MIR technique was adapted by the State of California in setting automotive emissions standards. Applying Carter's MIR factors to the means used in Table 4-3 changes the relative ranking and conditional importance of the PAMS target list. The overall top 10 reactivity-weighted compounds (using Carter's MIR factors) at operating PAMS sites in 1996 were: formaldehyde; ethylene; m&p-xylenes; propylene; toluene; isopentane; acetaldehyde; 1,2,4-trimethylbenzene o-xylene; and isoprene. These 10 compounds accounted for approximately 70 percent of the total PAMS targeted ozone-forming potential.

### Trends

Between 1995 and 1996, the number of ozone NAAQS exceedance days in PAMS areas declined 26 percent; be-

**Table 4-3.** PAMS Targeted VOCs Ranked by Mean 6–9 am Concentration, Summer 1996

Parameter	AIRS Code	Rank	# of Sites Reporting
Propane	43204	1	49
Isopentane	43221	2	51
Ethane	43202	3	49
Toluene	45202	4	53
n-Butane	43212	5	53
n-Pentane	43220	6	53
Ethylene	43203	7	49
Formaldehyde	43502	8	22
Acetone	43551	9	21
m&p-Xylenes	45109	10	53
Benzene	45201	11	53
2-Methylpentane	43285	12	53
Acetylene	43206	13	49
Isobutane	43214	14	52
2,2,4-Trimethylpentane	43250	15	53
Isoprene	43243	16	53
n-Hexane	43231	17	53
Propylene	43205	18	49
3-Methylpentane	43230	19	53
Acetaldehyde	43503	20	22
1,2,4-Trimethylbenzene	45208	21	53
o-Xylene	45204	22	53
3-Methylhexane	43249	23	53
Ethylbenzene	45203	24	53
Methylcyclopentane	43262	25	53
1,2,3-Trimethylbenzene	45225	26	44
2,3-Dimethylbutane	43284	27	53
2-Methylhexane	43263	28	53
n-Heptane	43232	29	53
2,3-Dimethylpentanane	43291	30	53
n-Undecane	43954	31	51
n-Decane	43238	32	51
m-Ethyltoluene	45212	33	46
2,3,4-Trimethylpentane	43252	34	53
Methylcyclohexane	43261	35	53
1-Butene	43280	36	50
p-Ethyltoluene	45213	37	46
Cyclopentane	43242	38	51
n-Octane	43233	39	53
2,4-Dimethylpentane	43247	40	53
1-Pentene	43224	41	53
Styrene	45220	42	53
2,2-Dimethylbutane	43244	43	53
1,3,5-Trimethylbenzene	45207	44	53
Cyclohexane	43248	45	53
n-Nonane	43235	46	53
o-Ethyltoluene	45211	47	46
t-2-Pentene	43226	48	50
3-Methylheptane	43253	49	53
n-Propylbenzene	45209	50	53
2-Methylheptane	43960	51	53
2-Methyl-1-Pentene	43246	52	52
p-Diethylbenzene	45219	53	44
t-2-Butene	43216	54	50
m-Diethylbenzene	45218	55	44
c-2-Butene	43217	56	50
c-2-Pentene	43227	57	50

tween 1994 and 1996 the number dropped by 21 percent. Table 4-4 shows the counts by individual area. Average summer daily ozone maxima declined 8 percent between 1995 and 1996 and 3 percent between 1994 and 1996. A summary of the 2-year and 3-year changes for ozone, selected VOCs, and NO<sub>x</sub> is shown in Table 4-5. Meteorologically adjusted ozone trends have been steadily declining across the United States in the past 10 years as seen in Figure 2-21 of Chapter 2.<sup>2</sup> Meteorological-adjusted ozone concentrations appear to be declining faster in the PAMS areas than elsewhere, especially in the last two years. Of the 41 MSAs evaluated with the referenced EPA adjustment technique (“Cox-Chu”), 18 of the MSAs correspond fairly well to PAMS areas. In Figure 4-3, data for those 18 areas are contrasted with the 23 non-PAMS areas. Meteorologically adjusted ozone concentrations are, most likely, declining as a result of VOC emissions controls.

For the second consecutive year, many PAMS sites showed significant reductions in total VOC and “key” ozone precursors. (Although a certain amount of caution should be exercised in using relative VOC reactivity rankings, this section does focus somewhat on the top 10 reactivity-weighted compounds mentioned in the previous section as computed using Carter’s MIR technique. Space limitations of this report prohibit inclusion of a more comprehensive summary.) Ambient levels of total VOC declined by around 15 percent between 1995 and 1996 (16 percent for “All Reported Hours” and 14 percent for “6:00–9:00 am”). This change corroborates well with emissions inventory data. Aggregate VOC emissions inventory estimates for the 21 PAMS nonattainment areas showed a drop of 12 percent between 1995 and

**Table 4-4.** Number of Ozone NAAQS Exceedance Days, by PAMS Area

Area	1994	1995	1996
Los Angeles-South Coast Air Basin, CA	118	98	85
Baltimore, MD	10	13	4
Baton Rouge, LA	4	11	4
Chicago-Gary-Lake County (IL), IL-IN-WI	2	4	5
Houston-Galveston-Brazoria, TX	24	48	26
Milwaukee-Racine, WI	3	5	2
New York-New Jersey-Long Island, NY-NJ-CT	11	16	9
Philadelphia-Wilmington-Trenton, PA-NJ-DE-MD	8	11	5
San Diego, CA	9	12	2
SE Desert Modified AQMA, CA	81	43	45
Ventura County, CA	17	23	17
Atlanta, GA	3	13	7
Boston-Lawrence-Worcester, MA-NH	3	5	2
Greater Connecticut, CT	5	10	2
El Paso, TX	6	4	2
Portsmouth-Dover-Rochester, NH-ME	1	3	0
Providence-Pawtucket-Fall River, RI-MA	1	4	0
Sacramento, CA	6	11	11
San Joaquin Valley, CA	43	42	56
Springfield, MA	3	2	0
Washington, DC-MD-VA	4	6	1
<b>Total PAMS Areas</b>	<b>362</b>	<b>384</b>	<b>285</b>
<b>Total All Ozone Nonattainment Areas<sup>1</sup></b>	<b>439</b>	<b>557</b>	<b>361</b>

<sup>1</sup>Original classified, unclassified, and section 185a ozone nonattainment areas.

1996. Of the 11 evaluated VOCs, only m&p-xylenes had a median site percent change increase between 1995 and 1996 ("All Reported Hours" and "6:00–9:00 am"); the median percent changes showed declines for all other parameters. Benzene, another VOC though not a major ozone precursor, is also highlighted in Table 4-5 as a follow-on to last year's analysis which showed a significant 1994–1995 reduction in benzene and other mobile-related VOC concentrations as a possible result of federally mandated RFG. Federally mandated RFG was implemented in most PAMS areas at the beginning of 1995. The 1995–1996 reductions in benzene and other mobile-related VOC concentrations were not quite as large as those seen from 1994 to 1995. Average benzene concentrations declined

by a median 38 percent in 1995—the first year of the RFG program—as compared to an 8-percent reduction in 1996. This smaller reduction in 1996 was not only expected since RFG was in place in both 1995 and 1996, but it supports the supposition that RFG contributed to the significant emission reductions between 1994–1995. The Office of Mobile Sources (OMS) is currently sponsoring an analysis of PAMS data to help verify the contribution of RFG to the large emissions reductions in 1995. For more information on benzene, see Chapter 5.

Between 1994 and 1996, the number of sites with significant declines outnumbered the sites showing increases for all 11 highlighted VOCs. Like ozone, annual variations in VOC concentrations can result from changes in meteorological conditions.

Nationwide, the summer of 1996 was cooler than the summer of 1994 and wetter than the summer of 1995, especially in some of the regions where many PAMS sites are located (e.g., Northeast and the South).<sup>3</sup> Hot and dry conditions are more conducive for photochemistry and thus, secondary production of VOCs, than are cool and wet conditions. Ambient concentrations of isoprene, a VOC of predominantly biogenic origin, are particularly sensitive to meteorological factors. Some of the VOC reductions seen between 1994 and 1996 and between 1995 and 1996 may, therefore, be explained by differing meteorological conditions. However, the large reductions seen since 1994 are too large to be credible without some human intervention (i.e., anthropogenic emissions reductions). The NO<sub>x</sub> concentration changes were fairly mixed over the three years evaluated. Between 1995 and 1996, reporting PAMS sites showed a median increase of 3 percent in daily concentrations and a 1-percent increase in 6–9 am levels. Between 1994 and 1996, NO<sub>x</sub> concentrations declined 6 percent.

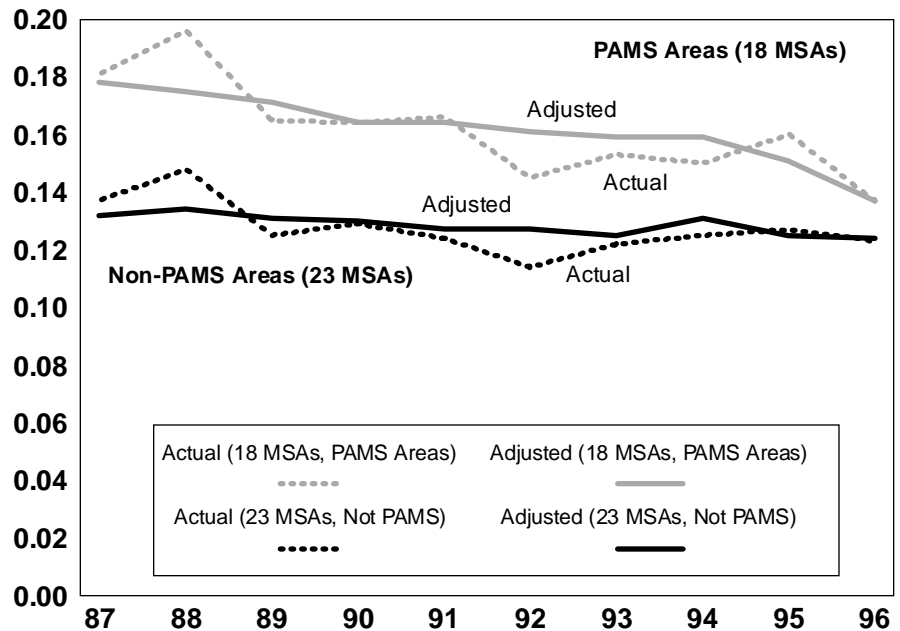
### NO<sub>x</sub> Versus VOC

Although the highlighted VOCs (minus benzene) shown in Table 4-5 have the highest (MIR method) ozone-forming potential overall at reporting PAMS sites, a blanket reduction in these compounds may not necessarily reduce ozone levels. Sometimes NO<sub>x</sub> reductions as opposed to VOC reductions will contribute more to reducing ozone concentrations. Ozone concentrations are sensitive to shifts in the relative abundance of VOC and NO<sub>x</sub>. In addition to local factors of influence (area emissions of VOCs and NO<sub>x</sub>, and meteorological conditions), ozone concentrations can be significantly impacted

by incoming transported ozone and ozone precursors. This is especially true in the northeastern United States where nonattainment areas lie in close proximity to each other. The PAMS networks are designed with the ability of quantifying the incoming and outgoing transport (i.e., Type 1 and Type 4 sites). The Ozone Transport Assessment Group (OTAG) identified areas that “contribute significantly” to ozone problems in downwind areas. On October 10, 1997 EPA proposed a rule to significantly reduce the transport of  $\text{NO}_x$  and ozone. For an expanded discussion of the proposed rule, see the Ozone section of Chapter 2.

## Summary

The PAMS networks produce a myriad of information invaluable to the development and evaluation of ozone control strategies and programs. A few examples include: VOC to  $\text{NO}_x$  ratios helpful for deciding what type of controls to seek; upper air and surface meteorological data capable of identifying transport trajectories; inter-species (benzene/toluene, xylene/toluene) components sufficient to quantify air mass aging; inputs to statistical models (regression and neural network analysis) capable of forecasting high ozone concentrations and identifying vital VOC species; and continuous speciated detail useful for corroborating inventories



**Figure 4-2.** Comparison of actual and meteorologically adjusted ozone trends—PAMS metropolitan areas versus non-PAMS areas, 1987–1996 (composite average of 99th percentile 1-hr. daily max. conc.)

and validating photochemical models (for detailed discussion of these topics, see the Data Analysis Support section of the PAMS web site). Further, the networks will provide long-term perspectives on changes in atmospheric concentrations of ozone and its precursors, provide information to evaluate population exposure, and most importantly, deliver a more complete understanding of the complex problem of ozone so that we can continue to develop strategies to reduce ozone concentrations and thereby protect public health and welfare.

## References

1. W.P.L. Carter (1994), *Development of Ozone Reactivity Scales for Volatile Organic Compounds*, J. Air & Waste Manage. Assoc. 44:881-899.
2. W.M. Cox and S.H. Chu, “Meteorologically Adjusted Ozone Trends in Urban Areas: A Probabilistic Approach,” *Atmospheric Environment*, Vol. 27B, No. 4, Pergamon Press, Great Britain, 1993.
3. D.T. Bailey, “Summer 1997 in Perspective,” <http://www.epa.gov/oar/oaqps/pams/summer97.pdf>, 1997.

**Table 4-5.** Summary of Changes in Summer Mean Concentrations for Ozone, NO<sub>x</sub>, and Selected VOCs, 1995–1996 and 1994–1996

2-Year Change, 1995 to 1996								
Parameter	All Reported Hours				6:00 to 9:00 am			
	# of Sites			Median Change	# of Sites			Median Change
	Total	#Up	#Down		Total	#Up	#Down	
Ozone (44201)—Avg. Daily Max.	66	3	30	-8%	—	—	—	—
Oxides of Nitrogen (42603)	51	24	18	3%	51	18	17	1%
Total NMOC (43102)	32	9	16	-16%	32	6	14	-14%
Ethylene (43203)	39	13	12	-4%	39	11	10	-2%
Propylene (43205)	39	10	16	-1%	39	10	13	-2%
Isopentane (43221)	36	9	10	-1%	36	8	5	-3%
Isoprene (43243)	39	8	22	-22%	39	4	15	-15%
Formaldehyde (43502)	18	1	13	-28%	18	2	10	-26%
Acetaldehyde (43503)	18	4	10	-10%	18	3	9	-16%
M&P-Xylenes (45109)	38	15	8	9%	38	12	6	2%
Toluene (45202)	39	12	12	0%	39	8	7	-4%
O-Xylene (45204)	39	12	17	-8%	39	10	13	-3%
1,2,4-Trimethylbenzene (45208)	38	10	22	-31%	38	8	17	-23%
Benzene (45201)	39	11	15	-8%	39	8	10	-5%
3-Year Change, 1994 to 1996								
Parameter	All Reported Hours				6:00 to 9:00 am			
	# of Sites			Median Change	# of Sites			Median Change
	Total	#Up	#Down		Total	#Up	#Down	
Ozone (44201)—Avg. Daily Max.	54	9	19	-3%	—	—	—	—
Oxides of Nitrogen (42603)	34	12	19	-6%	33	8	13	-6%
Total NMOC (43102)	16	3	11	-28%	15	0	9	-29%
Ethylene (43203)	19	2	13	-26%	16	1	11	-26%
Propylene (43205)	18	2	10	-21%	15	2	7	-8%
Isopentane (43221)	19	1	11	-21%	16	1	10	-28%
Isoprene (43243)	17	4	10	-16%	14	2	8	-28%
Formaldehyde (43502)	7	1	5	-26%	6	0	5	-29%
Acetaldehyde (43503)	7	1	6	-35%	6	1	5	-40%
M&P-Xylenes (45109)	18	2	12	-18%	16	0	11	-34%
Toluene (45202)	19	1	14	-26%	16	0	11	-31%
O-Xylene (45204)	19	2	14	-29%	16	0	13	-34%
1,2,4-Trimethylbenzene (45208)	16	2	10	-35%	14	2	9	-38%
Benzene (45201)	19	2	17	-42%	16	0	13	-44%

1. Note that the terms “#Up” and “#Down” refer to the number of sites in which the change in summer mean concentrations between 1994 and 1995, or 1994 and 1996, is a statistically significant increase or decrease (as determined by a t-test with a significance level of .05). The total number of sites (“Total”) may not necessarily equal the sum of the corresponding “#Up” and “#Down” categories.

2. Data qualifications

- Because states are permitted, with EPA consent, to customize their network sampling plans, the “all hours reported” means may not encompass all hours of the day or may encompass different hours from year to year and, therefore, may not be comparable. Annual approved network sampling plans are posted on the PAMS web site. Changes in sampling equipment and/or methods may also contribute to differences in yearly means. Data shown in the “Median Change” column are the medians of the individual site percent changes in summer means for all reporting (“Total”) sites. [Summer means were computed for every sites that reported both years. The year-to-year percent change in these summer means were arrayed by magnitude. The middle value is the “Median Change.”]
- Although data submitted to EPA’s Aerometric Information and Retrieval System (AIRS) follow quality assurance procedures, EPA recognizes the complexity of the VOC monitoring and analysis systems and realizes that errors may exist in the database. In general, VOC data quality has been improving over the lifetime of PAMS data.
- Measurements of carbonyl compounds (formaldehyde and acetaldehyde) have recently come under enhanced scrutiny at EPA. Development of a carbonyl field audit program is being planned for PAMS in order to help determine the overall quality of carbonyl measurements made for the program. Currently, the National Performance Audit Program (NPAP) does an excellent job in determining the analytical accuracy but an assessment of the field sampling component is also needed.

